

## Comparison of primer and revisional laparoscopic mini-gastric bypass (MGB) for failed restrictive procedures: 2-year results at a tertiary center

Revisional mini-gastric bypass (rMGBP) for failed restrictive procedures: 2-year results

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### Abstract

**Aim:** Revisional surgery is becoming a common and challenging practice in bariatric centers. The aim of this study was to evaluate laparoscopic mini-gastric bypass (MGB) as a revisional procedure for failed restrictive bariatric procedures.

**Material and Methods:** One hundred sixty patients who underwent MGB between April 2012 and December 2017 were included in this retrospective study. Revisional MGB was defined as rMGB performed after failure of a first restrictive procedure. The main outcome measures were the success of therapeutic strategies, morbidity, body mass index (BMI), and percentage of excess BMI loss (%EBMIL) before and after revision.

**Results:** Forty patients (25%) who had prior restrictive bariatric surgery (including 26 laparoscopic sleeve gastrectomies, 9 gastric plications, and 5 adjustable gastric bandings) underwent conversion to rMGB. Ninety patients (75%) underwent primary MGB (pMGB group). Both groups were comparable in age, gender, BMI, and preoperative co-morbidities. The pre-operative mean BMI of the rMGB group was  $45.5 \pm 7$  kg/m<sup>2</sup>. No increase in morbidity was found between the 2 groups. Two patients with pMGB and one patient required conversion to RYGB after rMGB because of intractable biliary reflux. At 2 years, mean BMI was 30.5 kg/m<sup>2</sup> and mean %EBMIL was 72% after rMGB; no significant differences were found compared with pMGB (BMI = 29.5 kg/m<sup>2</sup>, %EBMIL = 73%). Co-morbidities and remission rates were statically similar.

**Discussion:** The results of our study show that rMGB is a safe and effective revisional procedure after failed restrictive bariatric surgery compared with pMGB.

### Keywords

Bariatric surgery; Revision; Mini-Gastric bypass; Sleeve gastrectomy; Gastric plication

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## Introduction

Bariatric surgery currently represents the best treatment option for morbid obesity and its related diseases [1]. Over the past 25 years, laparoscopic adjustable gastric banding (LAGB) has been one of the most popular interventions until long-term studies reported a high rate of poor responders and band complications [2,3]. Laparoscopic sleeve gastrectomy (LSG) has recently become the most frequently performed bariatric procedure worldwide due to its simplicity, versatility, and effectiveness [4]. However, there are conflicting data, regarding long-term outcomes of LSG, especially in comparison with laparoscopic Roux-en-Y gastric bypass (LRYGB), and reflux consequences after this procedure are still a matter of concern [5,6]. Laparoscopic gastric plication (LGP) is an evolving technique that gained popularity with the idea of reproducing a sleeve gastrectomy but without tissue transection [7]. With an increasing number of purely restrictive procedures, the significant issue of weight regain is becoming more prevalent and many studies have reported unreliable long-term results [8]. Different procedures have been proposed as revisional surgery for the increasing number of patients who had previously undergone a failed and/or bariatric restrictive procedure (LAGB, LGP or LSG).

Previously published studies have mainly reported outcomes of conversion from restrictive surgery to LRYGB or purely malabsorptive procedures such as bilio-pancreatic diversion with duodenal switch (BPD/DS) or single anastomosis duodenal switch [9-11]. Laparoscopic MGB as a primary and revisional surgery is growing in adoption around the world [12]. Laparoscopic MGB bypass links the effect of RYGB as a low-pressure system and a less dangerous malabsorptive procedure than BPD/DS [13]. Thus, it associates the positive effects of BPD/DS and RYGB with further excess weight loss (%EWL) and the treatment of GERD. The current literature confirms the safety and long-term effectiveness of MGB as a primary procedure as well as a revisional surgery for failed gastric restrictive procedures [14,15]. The aim of this study was to present the short-term result of converting failed LAGB, LGP and LSG to rMGB from our high-volume bariatric center.

## Material and Methods

The local ethics committee of Selcuk University Hospital approved this study. All study participants were consented before retrospective data review and analysis. Data of the patients who underwent MGB in Selcuk University Hospital Department of Obesity and Metabolic Surgery between April 2012 and December 2017 were retrospectively reviewed. Patients who underwent revisional (rMGB) after failed restrictive obesity surgery were identified. Adjustable gastric band and gastric plication procedures are never performed in our clinic and these patients were referred to us at the tertiary unit. Primary and rMGB were performed by the same surgeon (FA) and followed the same standardized technique. The study was approved by the local Ethics Committee and the need for patients' informed consent was waived due to the retrospective nature of the study. The type of revisional surgery was determined by patient preference unless there is an absolute contraindication. Preoperatively, all patients underwent a standard preoperative evaluation consisting of an abdominal ultrasound, an upper

gastrointestinal endoscopy, and cardiac, pulmonary, and endocrinological evaluations. An upper GI contrast study was additionally performed in all revisional cases. A standard dietary protocol was followed for all patients. This protocol included a 1-month liquid diet and then a 1-month soft diet. A regular diet was allowed postoperatively at 2 months. No vitamin supplements or proton pump inhibitors (PPI) were prescribed during hospital discharge. Vitamin and mineral deficiencies were determined according to follow-up results. Patients were regularly followed up in the outpatient clinic under the guidance of an experienced dietician and a member of the surgical team. After the first follow-up visit on a postoperative day 7, follow-up visits were performed at 1, 3, 6, 12, and 24 months. Patients' data including patients' characteristics, comorbidities, preoperative BMI, percentage of excess BMI loss (%EBMIL), complications, and causes for revisional surgery were obtained from hospital charts and office records. Patient contact with a surgeon and dietitian was guaranteed through phone numbers or online.

## Surgical Technique

Laparoscopic one-anastomosis gastric bypass as a revisional procedure was performed as described by Rutledge [16]. The technique used for rMGB is based on a 5-port approach. For patients with previous SG, the gastric sleeve is dissected free from firm adhesion between the staple line and surrounding tissues, starting from the distal staple line and proceeding to the angle of His. For patients with previous GP, the plicated part of the stomach was dissected free from surrounding tissues and the line of sutures was disrupted only where the first staples were placed. The first step of rMGB involved a calibrated (36 F tube) sleeve using a 60-mm Medtronic Tri-Staple® (Medtronic Inc., Dublin, Ireland) removing all the excessive and/or plicated gastric tissue along with plication sutures.

For patients with previous AGB, the gastric band was freed from the surrounding capsule and adhesions and cut and extracted through the 15mm port. The internal fibrous tissue between the band and the stomach was removed as well to prevent stenosis of the tube at this level. The gastric greater curvature was then completely freed starting at 4 cm proximal to the pylorus using LigaSure (Covidien, Minneapolis, MN, USA) along with the direct release of lower sac adhesions and scarring to the left crus. A long, narrow gastric pouch was constructed starting from beyond the crow's foot to just lateral to the angle of His over a 36-Fr orogastric tube using a 60-mm Medtronic Tri-Staple. The final stapling was carried out just lateral to the gastroesophageal fat pad. A biliopancreatic limb of 200 cm was then measured from the ligament of Trietz using markings on the instruments as a guide. Gastrojejunostomy was then performed using a 45-mm Medtronic® (Medtronic Inc., Dublin, Ireland) linear stapler followed by continued absorbable barbed suture (V-Loc, Covidien, USA) closure of the stapler entry opening. There was no difference in the construction of gastrojejunostomy between the two groups. Also, we used a hanging suture between the gastric pouch and the afferent loop to minimize reflux and a retaining suture between the lower part of the pouch and the antrum to prevent it from twisting. A Closed suction drainage system was used along the resection margin.

Intraoperative methylene blue test was performed to exclude a leak. Increasing systolic blood pressure to 130 mmHg while decreasing the pneumoperitoneum pressure allowed the achievement of hemostasis at the staple line by cautery or oversuturing and abdominal drainage was left in place. Every patient who underwent a bariatric operation in our division had recorded video from the laparoscopic camera, that allows for time recording and video staff presentations, as well as a reference in case of medicolegal issues.

**Statistical analyses**

The statistical analyses were conducted by Statistical Package for Social Sciences software (SPSS v22, IBM Corp., Armonk, NY, US), and p value was considered significant when it was less than 0,05. The chi-square and Fisher’s exact tests were used for comparing the categorical data between independent groups. Independent-samples t-test was used to compare the continuous data, while Levene’s test was implemented to assess the equality of variance.

**Results**

Our retrospective review revealed that 160 patients underwent MGB surgery during the study period. Among these patients, 40 underwent revision (rMGB) after failed restrictive bariatric surgery (Table 1,2). The mean duration of surgery was 142±24 minutes in the rMGB group and 117±38 minutes in the pMGB group. No intraoperative and postoperative patient death was reported. In 1 patient (0.5%), major late morbidity was observed; this patient required conversion to an RYGB for intractable biliary reflux two years after rMGB. In the pMGB group, major early morbidity requiring surgery occurred in 4 patients (3.3%) (Table 3). One patient experienced late marginal ulcer perforation 4 years after MGB. This case was successfully treated by an emergency laparotomy. One patient who presented with bowel obstruction due to postoperative adhesions 3 years after pMGB was treated laparoscopically. Two patients who had intractable biliary reflux necessitated surgical treatment 3 and 4 years after pMGB. There was no significant difference between the two groups as per the early and late major morbidity rates. The mean BMI was 30.5±4 kg/m<sup>2</sup>, and the mean EBmil% was 72±11% two years after rMGB (Table 3). Two groups were similar in terms of BMI and EBmil% by the end of the follow-up period.

**Table 1.** Indications for a revisonal laparoscopic MGB

Factor	n (%)	Prior surgery (n)
Inadequate weight loss	29 (72.5%)	Sleeve = 22 Plication = 4 AGB = 3
GERD	5 (12.5%)	Sleeve = 4 Plication = 1
Gastric prolapse	4 (10%)	Plication = 4
Dysphagia	2 (5%)	AGB = 2

MGB= Mini gastric gastric bypass; GERD= gastrointestinal reflux disease; AGB=Adjustable gastric band

**Nutritional status and co-morbidities**

After 2 years, no cases developed severe malnutrition after pMGB and rMGB. Mean albumin level was 38 ± 4 g/L in the overall series and no significant differences were found between the 2 groups. Significant decrease in the rates of

**Table 2.** Clinical characteristics of morbidly obese patients before a revisonal or a primary laparoscopic mini-gastric gastric bypass

Variable	Primary MGB (n = 120)	Revisonal MGB (n = 40)	p	
Age (yr): mean ± SD	48.5 ± 15	52.5 ± 9	NS	
Gender	Female	76 (63.3%)	26 (65%)	NS
	Male	44 (36.6%)	14 (35%)	NS
BMI (kg/m <sup>2</sup> ): mean ± SD	47 ± 7	45.5 ± 6	NS	
Before surgery	LAGB	5 (12.5%)		
	LGP	9 (22.5%)		
	LSG	26 (65%)		
Hypertension	36 (30%)	13 (32.5%)	NS	
Hyperlipidemia	22 (18%)	8 (20%)	NS	
T2DM	20 (17%)	9 (22.5%)	NS	
Sleep apnea	18 (15%)	5(12.5%)	NS	

MGB = laparoscopic mini-gastric gastric bypass; SD = standard deviation; NS = not significant; BMI = body massindex; LAGB = laparoscopic adjustable gastric banding; LGP =laparoscopic gastric plication; LSG= laparoscopic sleeve gastrectomy T2DM = type 2 diabetes mellitus

**Table 3.** Early and late complications from revisonal and primary laparoscopic mini-gastric gastric bypass, and BMI , %EBMIL, remission rates comorbidities at 2 years

Variable	Primary MGB (n = 120)	Revisonal MGB (n = 40)	p
Hospital stay (days) (mean ± SD; range)	2.8 ± 1.2 (2–4)	4.6 ± 2.4 (2–7)	NS
Length of operation (min)	117 ± 38	142 ± 24	NS
Early complications (<3 mo)	4 (3.3%)	2 (0.5%)	NS
Anastomotic leak	0	0	
Marginal ulcer	1 (0.8%)	0	
Minor wound infection	3 (2.5%)	2 (0.5%)	NS
Late complications (>3 mo)	4 (3.3%)	1 (0.2%)	NS
Intractable biliary reflux	2 (1.6%)	1 (0.2%)	NS
Marginal ulcer/perforation	1 (0.8%)	0	
Bowel obstruction	1 (0.8%)	0	
Mortality	0	0	
BMI (kg/m <sup>2</sup> ): mean ±SD			
Month 0	47 ± 7	45.5 ± 6	NS
Month 12	32 ± 6	33 ± 4.5	NS
Month 24	29.5 ± 4	30.5 ± 4	NS
%EBMIL (%): mean ± SD			
Month 12	74 ± 27	61 ± 15	0.028
Month 24	73 ± 25	72 ± 11	NS
Remission rates comorbidities at 2 years			
Hypertension	55.5% (20/36)	61.5% (8/13)	NS
Hyperlipidemia	82% (18/22)	75% (6/8)	NS
T2DM	80% (16/20)	78% (7/9)	NS
Sleep apnea	61% (11/18)	60% (3/5)	NS

MGB = laparoscopic mini-gastric gastric bypass; SD = standard deviation; NS = not significant; BMI = body mass index; %EBMIL= percentage of excess BMI loss; T2DM = type 2 diabetes mellitus

hypertension, T2DM, hyperlipidemia and sleep apnea syndrome were observed at the end of the follow-up period compared with the preoperative period in each group. After 2 years, no significant differences were found in the remission rates of any obesity-related co-morbidities that occurred in the rMGB and pMGB groups (Table 3).

## Discussion

Weight loss failure is still a significant issue after bariatric surgery [17]. Therefore, revision surgery is becoming a common practice in bariatric centers. Today, as many as 15% of bariatric surgery procedures are revision surgeries; this number will likely increase shortly. Revision procedures are challenging for surgeons due to altered anatomy and firm adhesions [18]. In line with this, revision surgeries are associated with increased rates of perioperative surgical complications. Most of these complications arise from the gastric pouch or gastric remnant. Although LSG is a simple and popular bariatric surgery procedure, long-term data suggest that weight loss failure is not uncommon after this surgery with a conversion rate of up to 35.8% at 10 years [18]. The LGP is an evolving bariatric procedure; however, it is also associated with a high surgical revision rate [19]. It was reported that reaching 57.7% of all LGP procedures necessitated revision surgery within 18 months. Anatomical and surgical factors increasing the risk of weight regain after LSG procedure include an initial large sleeve, incompletely resected fundus, and a large remnant antrum [19]. On the other hand, dilatation or prolapse of gastric plication is the main factor related to weight regain after LGP. Single anastomosis duodenal-ileal bypass is currently considered as an effective salvage method for failed sleeve gastrectomy procedure. However, this procedure has the risks of duodenal fistula formation and malnutrition [20]. Alternatively, it can be converted to a functional single-anastomosis gastric bypass for revision purposes.

Our study compared the 2-year outcomes of 40 morbidly obese patients who underwent revision MGB for a failed restrictive bariatric procedure with those of 120 patients who underwent primary MGB. Our main findings indicate that rMGB is an effective and safe procedure in the long term. They also showed no significant increase in morbidity with rMGB procedure during a 2-year postoperative follow-up. Also, our cohort's major morbidity rate was in line with the rates reported in the literature for revision LRYGB performed secondary to a failed restrictive procedure [21–23]. As such, the 6.6% early major complication rate in our rMGB group appears to be acceptable. Our analysis elucidated that the two groups were similar in terms of weight loss. Besides, the mean EBML% of 66% at two years in our rMGB group compares favorably with the post-rRYGB EBML% reported in the literature [21,22]. This finding supports the hypothesis that rMGB can provide weight loss successfully after a failed restrictive bariatric procedure.

The long-term efficacy of MGB expresses itself also by proper management of obesity-related co-morbidities, including T2DM [15,24]. In our study, remission rates from all co-morbidities were improved, and they were similar between two patient groups: Approximately 78% of the T2DM patients in the rMGB group experienced remission; this rate was 80% for the patients in the pMGB group. These promising results regarding weight loss and management of obesity-related co-morbidities are consistent with the outcomes reported for rLRYGB in the current literature [21,22]. Also, they encourage performing rMGBP for surgical treatment of morbid obesity after a failed restrictive bariatric procedure.

Our study has some weaknesses which should be considered

while evaluating its findings. First, it is a retrospective study that could be affected by all inherent limitations stemming from its retrospective design. Second, our data did not include the results of the tests assessing esophageal pressures such as esophageal manometry and additional tests such as pH, upper gastrointestinal endoscopy, and upper gastrointestinal series. Since patient stress and anxiety can also affect the outcomes, the fact that we did not assess our patients' stress and anxiety levels can be considered as another limitation of our study.

## Conclusion

Laparoscopic revisonal bariatric surgery is technically demanding but it is safe and effective when the causes of failure of the primary procedure were identified, addressed and corrected by an experienced laparoscopic team. Revisonal procedures involving the addition of malabsorption result in a greater weight loss than gastric restriction alone. The results of our study show that rMGB after a failed restrictive procedure was well tolerated and effective compared with primary surgery in the mid-term. Further studies are required.

## Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

## Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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## Conflict of interest

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